carpus eriophyllus Benth., Journ. Linn. Soc. 4: Suppl. 94. 1860.

Type locality: Chilla, State of Puebla, Mexico, *Andrieux 439.*

Distribution: Lava fields and rocky gulches, States of Puebla, Morelos, and Guerrero, Mexico.

Representatives: *Langlassé 236; Pringle 8987, 11348.*

6. **Willardia argyrotricha** (Harms) Hermann, comb. nov. *Lonchocarpus argyrotrichus* Harms, Fedde Rep. Spec. Nov. **17**: 320. 1921.

Type locality: Near Tlaxmalac, District of Hidalgo, State of Guerrero, Mexico, *Seler 4276*

Distribution: Hills, States of Mexico and Guerrero, Mexico.

Representatives: *Hinton 7085, 8059; E. W. Nelson 2043; Seler 4276.*

In addition to the characters given in the foregoing key for the hitherto undescribed pods. represented in *Hinton 7085*, it may be mentioned that they are approximately oblong in outline, thick-margined, especially the vexillar suture, deep tan in color, and 1–3-seeded (seed 13 by 9 mm, semilunate, dark mahogany-red). The blades of the leaflets, borne on petiolules 6–8 mm long, are strigose above and somewhat appressed-pilose beneath; in *Hinton 7085* (in fruit) they are oblanceolate, tapering at the base, with an abruptly acuminate apex (45–63 mm by 18–22 mm), whereas in *Hinton 8059* (same tree in flower) they are oval-elliptic, rounded at the base, and obtuse at the apex (75 by 30 mm).

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ENTOMOLOGY.—*A new species of* Pristoceuthophilus *from Oregon, and remarks on certain special glands of Orthoptera (Gryllacrididae; Rhaphidophorinae).*[1]

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(Communicated by R. E. Blackwelder.)

The genus *Pristoceuthophilus* occurs in Mexico and the western parts of the United States and Canada. The species superficially resemble those of the well-known genus *Ceuthophilus* but differ conspicuously in that males of most species bear large spines, tubercles, or other distinctive structures on the dorsum of the abdomen. There are additional differences between the two genera, such as the crenulations of the ovipositor of *Pristoceuthophilus*, rather than distinct teeth which rarely are absent in *Ceuthophilus*, and the absence in *Ceuthophilus* of a basal, ventral, sensory seta on each tarsal claw. My friend Borys Malkin, of the University of Oregon, has recently sent to the National Museum specimens of a new species of *Pristoceuthophilus*, which has the dorsum of the male abdomen specialized in a very ornate and remarkable manner. The only previously described species which approaches the new one in dorsal specialization is *gaigei* Hubbell, 1925, described from the Olympic Mountains, Mason County, Wash. Although there is no definite information concerning the benefits which these insects may derive from the specialized abdominal structures, glandular activity may be involved, and a discussion of such functions in related Orthoptera is included to point out the nature of this possibility.

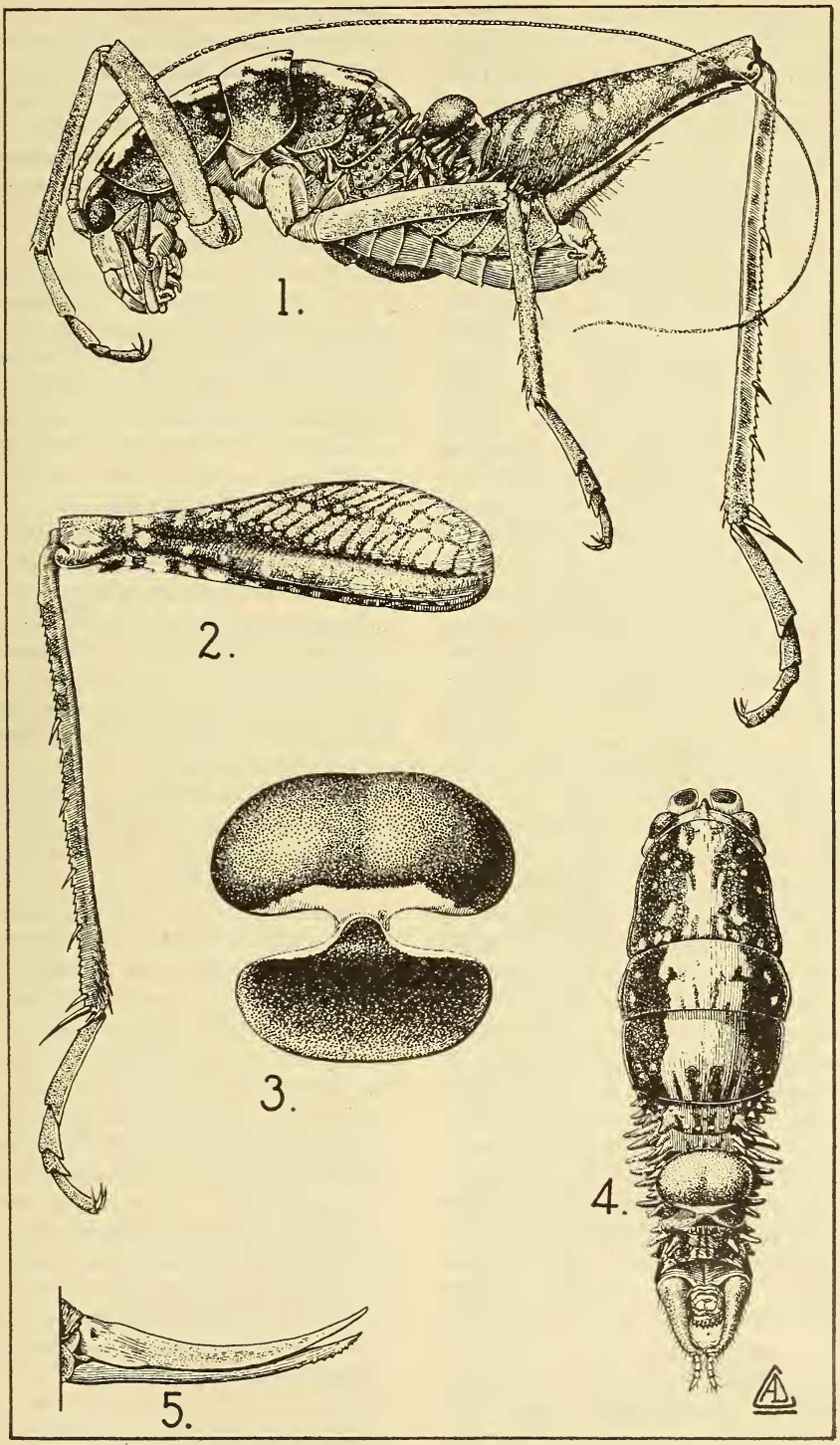
My appreciation is extended to Mr. Malkin for making this interesting species available for study; also to my colleague Arthur D. Cushman, for preparing the illustrations.

Pristoceuthophilus sargentae, n. sp.

Figs. 1–5

Male (holotype).—General size about average for genus. Head with fastigium extending in front of eyes, moderately less elongate and acute than in *celatus* (Sc.). Antenna delicate, slender, with about 130 segments (plus a few lost apical ones).

[1] Received May 22, 1947.



Figs. 1–5.—*Pristoceuthophilus sargentae*, n. sp.: 1, Holotype, lateral view (left hind leg missing); 2, same, externolateral view of right hind leg; 3, same, posterior view of Hubbell's organ; 4, same, dorsal view (legs and antennae not shown); 5, allotype, lateral view of ovipositor. (Drawings by Arthur D. Cushman.)

Thorax as figured; metanotum with about 12 tubercles, varying from low to indistinct, on ventroposterior portion of each side. Front femur unarmed. Front tibia with 3 small spurs on each ventral margin, distal one scarcely more than half the length of 2 basal ones; 2 apical spurs on each side, dorsal one two-thirds the length of ventral one, ventral apical spur slightly longer and stouter than basal spur of ventral tibial margin. Middle femur with 2 (right femur) or 3 (left) spurs, varying from minute to small, on each ventral margin; genicular lobe of posterior surface with a single spur. Middle tibia with 2 (right) or 3 (left) staggered dorsal spurs and 3 pairs of ventral spurs; 2 apical spurs on each side, dorsal one about three-fourths the length of ventral one. Hind femur with short, acute tooth at apex of each ventral carina, preceded by 6 (anterior) or 9 (posterior) serrations which decrease in size toward base of femur; genicular lobe unarmed. (Left hind leg lost.) Hind tibia straight, with 5 pairs of dorsal spurs, interspersed with numerous serrations; apex armed on each side with 2 small ventral spurs, a medium sized one at extreme apex and a dorsal one twice the length of apical one, posterior dorsal spur slightly longer than anterior one and three-fifths dorsal length of basal tarsal segment.

Abdomen with terga I–VIII armed with blunt tubercles and long, conical spines as figured; basic arrangement of spines and tubercles 2 rows per tergum, a partial third row on tergum I, anterior row lacking on terga VII and VIII, development on median portion of terga obsolete; posterior row of tubercles developed nearly to ventral margin on terga I–III, extending decreasingly short of ventral margin on succeeding terga; armature of tergum VIII reduced to 1 small and 2 obsolete posterior tubercles each side of median line. Tergum IV bears a large median structure with a subovate anterior portion covering entire median portion of III and posterior margin of II; a posterior development of this organ vertical, shelflike, covering median portion of V and anterior margin of VI; this organ well sclerotized (with exception of region of median constriction, shown pale in illustrations), anterior half smooth and shining, posterior half minutely roughened, traces of what may be secretory pores at point of maximum constriction. Cercus with basal two-thirds unsegmented, this portion terminated medially by a densely pubescent, hemispherical knob, apical third comprising 5 segments. Supra-anal plate triangular, longitudinally grooved. Ventral aedeagal lobe membranous, covered medially with short, stout spinules. Subgenital plate simple, broadly emarginate apically, each lateral posterior angle bearing a short, simple style.

Coloration: Pattern of dorsal surface as in Fig. 4, with dark areas of black grading on lateral portions of nota into russet and, at ventral extremities of nota, into gray mottled with dark spots; pale areas of vertex and nota amber yellow; fastigium black with a pale gray transverse band midway of its length; spines and tubercles of terga mustard yellow, a few dark brown at base, some short ones, particularly on tergum I, entirely dark; special organ of IV cinnamon-buff; antennae ochraceous-orange in basal third, annulate with occasional pale brown segments, the latter more numerous apically, giving a predominantly brown color, with pale annulations at intervals. Ground color of legs predominantly dark purplish gray, spotted and streaked with lighter color varying from amber yellow to straw yellow; tarsi mainly amber yellow.

Measurements (length in millimeters): Body, 11.5; antenna, approximately 28; pronotum, 3.3; front femur, 4.5; hind femur, 9.4; hind tibia, 10.5; cercus, 2.8.

Female (allotype).—General form as in male; somewhat larger and more robust (though body is shorter due to different position); differing as follows: Front femur with small subapical spur on ventroanterior margin; middle femur with minute subapical spur on ventroposterior margin, otherwise unarmed except for posterior genicular spur (right middle leg lost); hind femur without apical teeth on ventral carinae, about 6 (anterior) and 9 (posterior) serrations on apical third of carinae; posterior dorsal spur of apical group on hind tibia seven-eighths dorsal length of basal tarsal segment. Thorax and abdomen simple, normal for females of genus. Cercus unspecialized, obsolete segmentation indicated on apical half. Subgenital plate simple, the apex broadly and evenly rounded. Ovipositor smooth, shining; lower valve with 9 ventral crenulations on apical fifth (Fig. 5).

Coloration: Nota with a median, longitudinal pencil stripe of ivory yellow; pale areas not confluent as in male, consisting of general

sprinkling of amber-yellow spots on dark background. Terga spotted as on nota. Ovipositor empire yellow, basal fourth somewhat paler. Antennae darker than in male. Coloration otherwise essentially as in male.

Measurements (length in millimeters): Body, 11.0; pronotum, 3.6; front femur, 4.9; hind femur, 10.0; hind tibia, 11.6; cercus, 3.0; ovipositor, 6.0.

Nymphs.—There are 2 male and 5 female nymphs, varying in body length from 7 to 10 mm (hind femur, 6–7 mm). Males show traces of dorsal tubercles, no sign of organ on tergum IV. Dorsal color pattern essentially as in male type, in one female varying toward that of allotype. Antennae brown, with pale annulations at intervals.

Type locality.—Oregon Skyline Trail, Three Sisters Primitive Area, Lane County, Oreg. (elevation 5,700–6,000 feet).

Type.—Male, U.S.N.M. no. 58319.

The male type, female allotype, and seven immature specimens were collected August 18, 1946, on the Oregon Skyline Trail about 3 miles from Frog Camp. (Collectors: Samuel Sargent, Mrs. Sargent, Borys Malkin.) This part of the trail is sometimes called Obsidian Trail. Mr. Malkin writes that more than 20 specimens were seen, scattered from 1 to 6 feet above ground, all under the loose bark of a single standing tree. Only the specimens here reported were captured. The tree was believed by him to be the mountain hemlock (*Tsuga mertensiana* (Bong) Sarg.), of which there is a large stand in the vicinity, or possibly the silver (or lovely) fir (*Abies amabilis* (Dougl.) Forbes). The tree is located at a point on the trail just before the latter turns and follows the first lava flow from the Middle Sister. (The Three Sisters are the remnants of extinct volcanoes, each said to have been originally more than 10,000 feet high.)

The species is named in honor of Mrs. Samuel Sargent, whose enthusiasm for collecting, together with that of her husband, contributed significantly to the discovery of this unusual camel-cricket.

This species is most closely related to *gaigei*, from which it differs noticeably in the shape of the dorsal organ of tergum IV. This organ in *gaigei* does not overlap III anteriorly, and only slightly over V posteriorly. The median posterior spines of terga V–VII of *gaigei* are distinct, much larger than the obsolete ones of *sargentae*. The latter is a somewhat larger species than *gaigei*. The cerci do not differ from those of *cercalis* Caudell but are more slender than those of *tuberculatus* Caudell. With the exception of *gaigei* and *tuberculatus*, the straight hind tibia of *sargentae* separates it from most species of *Pristoceuthophilus*. *P. tuberculatus* differs in the specialization of the terga, as well as in the more robust cerci.

Since the original description in 1903, *Pristoceuthophilus* has been compared with *Ceuthophilus* and related genera by Caudell (1916) and Hubbell (1936). Only *arizonae* Hebard (1935) and *gaigei* have been described since 1916. The former differs from most other species in the smooth dorsum of the male abdomen. Karny (1937) published a list of species, but it appears fairly certain that several of the 11 species he recognized are synonyms. Hubbell (1932) has pointed out that the unique type of *rhoadsi* Rehn, the Mexican genotype, is immature, so it is possible that the other species now included in *Pristoceuthophilus* will eventually be found to represent a distinct genus.

The dorsal abdominal organ of the adult males of *gaigei* and *sargentae* is of a type unique in gryllacridids, so far as I am aware, and it establishes these species as two of the truly remarkable Nearctic Orthoptera. I propose to call this special organ *Hubbell's organ*[2] in recognition of the searching, comprehensive studies on Orthoptera conducted by T. H. Hubbell, who first described this structure in *gaigei*. Until further studies are made, we can only speculate concerning the function, if any, of Hubbell's organ. Perhaps it is the result of an evolutionary development which did not involve function, merely bizarre shape. It seems more likely, however, that glandular activity is associated with the organ, or that such has at one time been the case in the evolution of these insects, though only the functionless structure may now remain.

An unusual type of tergal specialization was

[2] Uvarov (1943) has applied the name *Krauss's organ* to a specialized structure of unknown function, though suspected of being sensory, found in both sexes of most grasshoppers of the subfamily Pamphaginae. The organ consists of a shallow chamber, covered by a sclerotized plate bearing tubercles or ridges, located on each side of the body in the ventro-anterior part of tergum II.

described by Hebard (1939) in *Salishella mirabilis*, a then new genus and species of Rhaphidophorinae from Pierce, Idaho. The male has two conspicuous transverse ridges on each of the basal 7 terga, one ridge median, the other at the posterior margin. It is barely possible that the origin of these ridges is akin to that of the specialization of *Pristoceuthophilus*, though the appearance of the two genera is quite different. Because of the likelihood that function may be associated with Hubbell's organ, the following information on the specialized physiology of certain Orthoptera is given with the hope that it will stimulate future students to make anatomical or life-history studies of *Pristoceuthophilus*.

NOTES ON THE SPECIAL GLANDS OF CERTAIN ORTHOPTERA

With the possible exception of mantids, all major families of Orthoptera contain certain species that possess specialized glands, usually on the thorax or abdomen, which serve either to attract the female at time of mating or to protect the insect from enemies by virtue of repugnatorial qualities. Among the best-known examples are the metanotal glands (glands of Hancock) of *Oecanthus* males (tree crickets) and the tergal glands of *Blattella* males (German cockroach and relatives), which attract females, and the prothoracic glands of *Anisomorpha* which enable this large walkingstick to eject a milky fluid that is extremely painful to the human eye (see Stewart, 1937, Maynard, 1889). A good general treatment of these glands, as found in Orthoptera, is that of Chopard (1938), who includes references to the more important of the fairly numerous papers dealing with special glands of Gryllacrididae and Tettigoniidae, as well as those of other families. Packard (1898) has discussed defensive glands of insects as a whole.

Males of at least two genera of Gryllacrididae (*Troglophilus*, *Hadenoecus*) have glands, ordinarily concealed beneath the body wall, which occasionally are everted and extruded between certain of the terga. In other genera (*Dolichopoda*, *Tachycines*) glands have been reported which are located in the region of intersegmental membranes of the terga and are attractive to females, though extrusion may not occur. Hancock (1905) reported an eversible gland which he found protruded between terga III and IV of the male of *Oecanthus*.

Seven or more genera of Tettigoniidae emit fluid from special openings in the body wall or from intersegmental membranes of the body or legs. Frequently the fluid is merely the blood of the insect, but in other cases glands secrete special fluids, though in either type defense appears to be the primary function in the majority of species. An example of what may be a combination of defense and sexual attraction is furnished by *Bradyporus multituberculatus* Fisch.-Waldh., a clumsy inhabitant of the uncultivated Russian steppes which somewhat resembles the Mormon cricket, *Anabrus*, in general habitus. Boldyrev (1928) has studied this species in detail. In both sexes there are slits borne on raised longitudinal ridges on the pronotum, metanotum and terga I-IX. Blood from within the body is ejected from these slits, sometimes to a distance of about 5 inches, but the ejection is definitely associated with the application of pressure to the sides of the body. This occurs when the insect is seized, and from males when females climb upon them during mating. While mating, the female often bites pieces from the hind margin of the pronotum, and, as the pressure starts the flow of blood, drinks it greedily.

The male of a Palearctic phaneropterine katydid, *Isophya acuminata* Brunn., has a specialized heart-shaped area in the middle of tergum I which bears short glandular hairs arranged in two broad longitudinal rows. The remaining surface of the tergum is smooth. Engelhardt (1915) has described the histology of this organ, which he believes is comparable to the metanotal glands of male *Oecanthus*, though of a much simpler structure. He says the female of *acuminata* applies her mouth to the glandular hairs during mating. The hairs are associated with secretory cells located in the body wall. There is no special reservoir for the fluid, which simply gathers among the hairs when glandular activity is stimulated.

So far as I know, no New World tettigoniid has been shown to have special glands or adaptations for emitting fluid

either as a means of defense or an attraction for the opposite sex. The products of secondary sexual glands in the perianal region or those of regurgitation are in another category.

It is the habit of many female Orthoptera to eat the spermatophore after it has been attached to her body by the male. Boldyrev (1914) has stressed the importance of protecting the spermatophore of Gryllidae and Tettigoniidae after mating until the spermatozoa have passed into the female's body. Substances produced by the male which are attractive to the female frequently serve to prevent her from consuming the spermatophore quickly. It is probable that in the long course of evolution an important impetus toward the successful development and survival of certain species has been supplied by the functions of the specialized male glands discussed in the foregoing paragraphs.

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